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University of Hawaii at Manoa

Hawaii's Pollution Prevention Information
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HAPPI-Home 9

Drinking Water Wells

Some people get most of their water from their own well. Other wells are used to provide water for livestock. All of these wells tap into local sources of water under the ground (groundwater) to provide clean, safe drinking water. However, improperly constructed or poorly maintained wells can allow for fertilizers, bacteria, pesticides, or other materials to enter the water supply.

Well-water pollution can make you or your livestock sick. Once a well is polluted, cleaning it up is difficult and costly. If your well is polluted, you will probably have to treat the water, drill a new well, or get water from another source. This worksheet will help you examine how you manage your well and how your activities may affect well-water quality. It will also show you how to take precautions to help keep your well safe from pollution.

Water testing

A water test is the only way to find out what is in your well water. Everyone should regularly test for the four most common indicators of trouble: bacteria, nitrate, pH, and total dissolved solids (TDS). You should also test for the contaminants that might be found at your location. For example, if you have lead pipes, soldered copper joints, or brass parts in the pump, test for the presence of lead. Test for volatile organic chemicals (VOCs) if there has been a nearby use or spill of oil, liquid fuels, or solvents. Pesticide tests, though expensive, may be justified if your well has nitrate levels of more than 10 milligrams per liter (mg/l) of nitrate-nitrogen (NO_3-N) or 45 mg/l of nitrate (NO_3). A test is also a good idea if a pesticide spill has occurred near the well. Pesticides are more likely to be a problem if your well is shallow, has less than 15 feet of casing below the water table, or is located in sandy soil and is downslope from irrigated lands such as farms or golf courses where pesticides are used. You should also test your water if

- Someone in your household is pregnant or nursing.
- An unexplained illnesses has occurred in the family.
- A dangerous contaminant was found in your neighbor's well.
- The water's taste, odor, color, or clarity changes.
- You have a spill of chemicals or fuel into or near your well.

Keep a record of your results with your well's construction and maintenance records so you can monitor water quality over time.

The Safe Drinking Water Branch of the Hawaii Department of Health can provide information on approved water-testing laboratories. They can be contacted by phone at the following numbers:

Hawaii: ..... 974-4000 ext. 64258
Maui: ..... 984-2400 ext. 64258
Kauai: ..... 274-3141 ext. 64258
Molokai and Lanai: ..... 1-800-468-4644 ext. 64258
Oahu: 586-4258

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Well location

Your well's location relative to potential pollution sources is very important. Try to locate a well where surface water, like stormwater, drains away from it. If a well is downhill from a leaking fuel-storage tank, septic system, or overfertilized farm field, it runs a greater risk of becoming contaminated than a well on the uphill side of such pollution sources.

Hawaii law requires that new wells be located at certain minimum distances from pollution sources (Table 1). Separating your well from a pollution source will help but does not guarantee that the well will be safe.

Because most potential water pollutants come from the surface, deeper wells are generally safer than shallow wells. Water in deeper aquifers (areas underground where water accumulates) has generally moved through more soil, and many pollutants have been filtered out. National guidelines recommend that drinking-water wells be at least 50 feet deep. Wells deeper than 50 feet can still become polluted. However, if your well is less than 50 feet deep, you need to be even more careful about contamination risks.

Pollution risks are greater when water moves quickly through the soil above your well. Water moves quickly through sandy soils, gravelly soils with many rocks, and well aggregated soils that form small clumps. All of these are considered porous soils. If the water going through porous soil is carrying pollutants such as pesticides, nitrate from fertilizers, or household chemicals, they can get into the groundwater more easily and pollute your well water. Although you cannot tell what the soil looks like underneath the ground by looking only at the surface, the soil surface is a good place to start. If you live in an area where the surface soil is porous, it is more likely that the soil underneath may also be porous, and you need to take extra care. You can get a better idea of what is under the ground by looking at the drilling records from your well or from a nearby well. If you do not have your own records, check the yellow pages for licensed well drillers in your community who may be able to give you additional information.

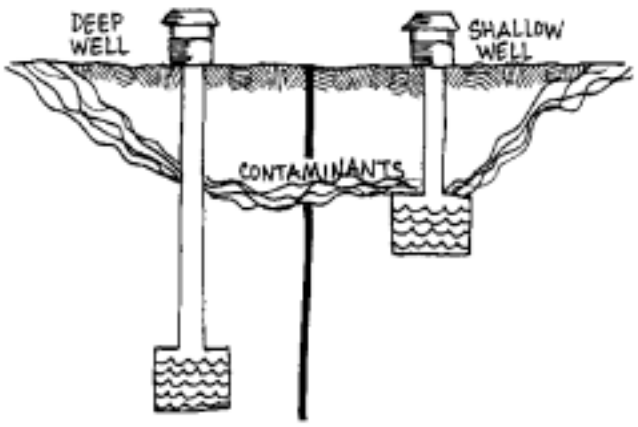


Table 1. Minimum distances from potable water wells*

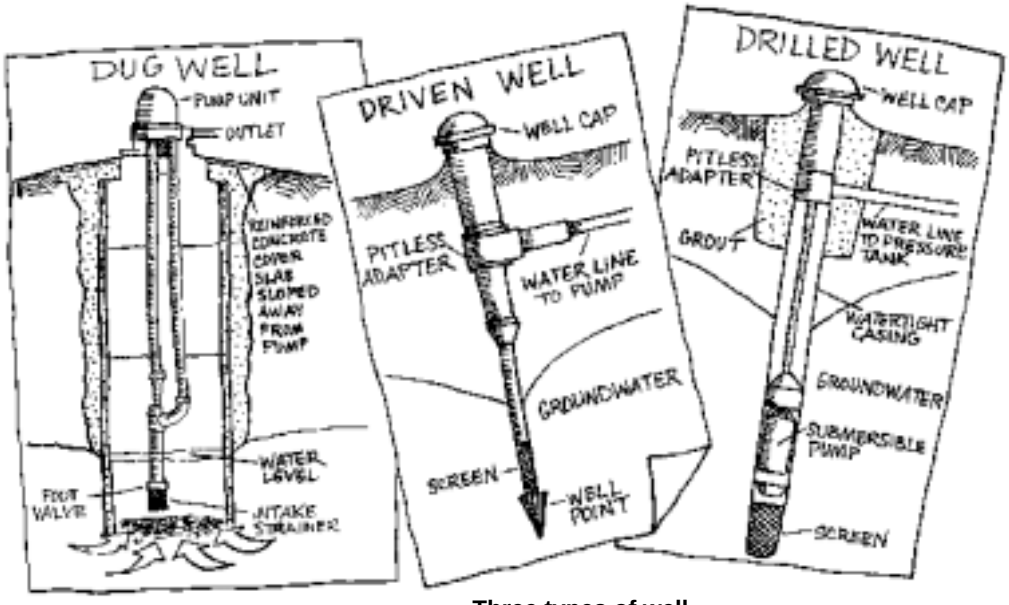
Source of pollution	Minimum horizontal distance from pollution source
Any sewer line	50 ft
Cesspool, septic tank, or subsurface sewage leaching field	1000 ft
Hazardous waste landfills and ponds, or chemical storage	1000 ft
Treated effluent injection well	¼ mile

*From *Hawaii well construction and pump installation standards* (updated 1997), page 2–4.

Well construction and maintenance

Older wells are more likely to be polluted. Wells more than 50 years old are often shallow and poorly constructed, with thinner casings that may be cracked or corroded. Older well pumps are more likely to leak lubricating oils, which can get into the water. Even wells with modern casings that are 30–40 years old are subject to corrosion and perforation. If you have an older well, you may want to have it inspected by a qualified well driller. If you don't know how old your well is, assume it needs an inspection.

A dug well is a large-diameter hole that is usually more than 2 feet wide and often constructed by hand. Dug wells are usually shallow and poorly protected from surface water runoff. Driven-point (sand-point) wells, which pose a moderate to high risk, are constructed by driving lengths of pipe into the ground. These wells are normally around 2 inches in diameter and less than 25 feet deep and can only be installed in areas with loose soils such as sand. Most other types of wells are drilled



Three types of well

wells which, for residential use, are commonly 4-8 inches in diameter. Because the water table in much of Hawaii is very deep, most wells are drilled wells. But, there may be dug or driven wells on some older properties, particularly in coastal and windward areas and areas where they were used for livestock.

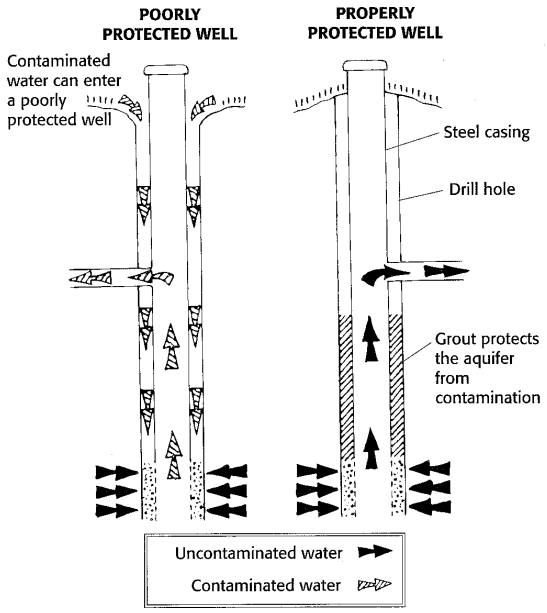
Well casing and cap protection

Well drillers install a steel or plastic pipe "casing" to prevent collapse of the well hole during drilling. The space between the casing and sides of the hole is a direct channel for surface water and pollutants to reach the water table. To seal off that channel, drillers fill the space with cement or a type of clay called bentonite.

You should visually inspect the condition of your well casing for holes or cracks. Examine the part that extends up out of the ground. Remove the cap and inspect inside the casing using a flashlight. If you can move the casing around by pushing it, the casing may not be able to keep out contaminants. Sometimes damaged casings can be detected by listening for water running down into the well when the pump is not running. If you hear water, there might be a crack in the casing, or the casing may not reach the water table. Either situation is risky.

The depth of casing required for a well depends on the depth to groundwater and the nature of the soils and bedrock below. In sand and gravel soils, well casings should extend to a depth of at least 20 feet and should reach the water table. For wells in bedrock, the casing should extend through the weathered zone and into at least 10 feet of bedrock. A minimum of 20 feet of casing should be used for all wells. Your well records should show how deep the casing extends.

The casing should extend at least 12 inches above the ground surface. If there are occasional floods in your area, the casing should extend 1–2 feet above the highest flood level recorded for the site. The ground around the casing

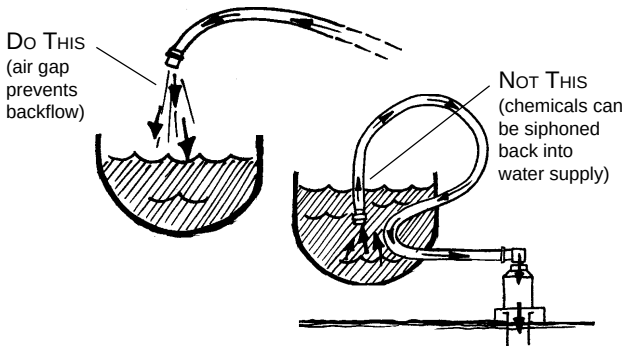


should slope away from the top of the well in all directions to prevent water from pooling around the casing.

The well cap should be firmly attached to the casing, with a vent that allows only air to enter. If your well has a vent, it should face the ground, be tightly connected to the well cap or seal, and screened to keep insects out. Wiring for the pump should be secured in an electric conduit pipe.

Backflow and inspection

Backflow of contaminated water into your water supply can occur if your system undergoes sudden pressure loss. Pressure loss can occur if the well pump fails. The simplest way to guard against backflow is to leave an air gap between the water supply line and any reservoir of "dirty" water. For example, if you are filling a swimming pool with a hose, make sure that you leave an air



gap between the hose and the water in the pool. Toilets and washing machines have built-in air gaps.

Where an air gap cannot be maintained, a backflow prevention device such a check valve or vacuum breaker should be installed on the water supply line. For example, if you are using a pesticide sprayer that attaches directly to a hose, a check valve should be installed on the faucet to which the hose is connected. Inexpensive backflow prevention devices can be purchased from plumbing suppliers.

Well equipment doesn't last forever. Every 10–15 years, your well will require inspection by a qualified well driller or pump installer. You should keep well-construction details and also the dates and results of maintenance visits for the well and pump. Keep good records so you and future owners can follow a good maintenance schedule.

Unused wells

Sometimes properties have wells that are no longer used. Sites with older homes or farms may have an abandoned, shallow well that was installed when the structure was first built. Abandoned, shallow wells are more likely to be found in coastal and windward areas and areas where they were used for livestock. If not properly filled and sealed, these wells can provide a direct channel for waterborne pollutants to reach groundwater (see p. 6).

A licensed, registered well driller or pump installer should be hired to close these wells, because experience with well construction materials and methods and knowledge of the geology of the site is needed. The cost to close a well varies with well depth, well diameter, and soil or rock type. The money spent sealing a well will be much less than the cost of pollution cleanup or the decrease in property value if your drinking water well becomes polluted.

Assess your risks

Use the table on pages 5–6 to rate your risks of pollution hazard. For each question, indicate your risk level in the right-hand column. Although some choices may not correspond exactly to your situation, choose the response that fits best. Then, on page 7, develop an action plan to minimize pollution risks for your well water.

Risk Assessment Table for Well Water

	Low risk	Moderate risk	High risk	Your risk
Water testing	Consistent, good water quality. Tests meet standards for bacteria, nitrate, and other contaminants	Some tests do not meet standards or tests approach standards; testing is infrequent (less than once per 2 years)	Water is not tested; water is discolored after a rainstorm; changes in color, odor, and taste are noticable	❑ low ❑ moderate ❑ high
Position of well in relation to pollution sources	Well is uphill from all pollution sources; surface water doesn't reach well or is diverted	Well is level with or uphill from most pollution sources; some surface water runoff may reach well	Well is downhill from pollution sources or in a pit or depression; surface water runoff reaches well	❑ low ❑ moderate ❑ high
Separation distances between well and pollution sources	Distances from potential pollution sources meet or exceed all state minimum requirements		Distances from any potential pollution sources do not meet state minimum requirements and thus are illegal	❑ low ❑ high
Well depth	> 50 ft deep	20–50 ft deep	< 20 ft deep	❑ low ❑ moderate ❑ high
Soil type	Soil fine-textured (clay loam or silty clay), or poorly aggregated	Soil medium-textured (loam)	Soil coarse-textured (sand, sandy loam, or gravel) or highly aggregated	❑ low ❑ moderate ❑ high
Well age	< 20 years old	20–50 years old	> 50 years old	❑ low ❑ moderate ❑ high
Well type	Drilled	Driven-point (sand-point)	Dug	❑ low ❑ moderate ❑ high
Casing height above land surface	Casing is > 12 inches above the surface; if the area floods, casing is 1-2 feet above the highest recorded flood level	Casing is at the surface or up to 12 inches above the surface	Casing is below the surface or in a pit or basement	❑ low ❑ moderate ❑ high
Condition of casing and well cap (seal)	No holes or cracks are visible; cap is tightly attached; a screened vent faces the ground	No holes or cracks are visible; cap is loose	Holes or cracks are visible; cap is loose or missing; running water can be heard or seen	❑ low ❑ moderate ❑ high
Casing depth relative to land surface	Casing extends > 50 ft below the land surface	Casing extends 20-50 ft below the land surface	Casing extends < 20 ft below the land surface	❑ low ❑ moderate ❑ high

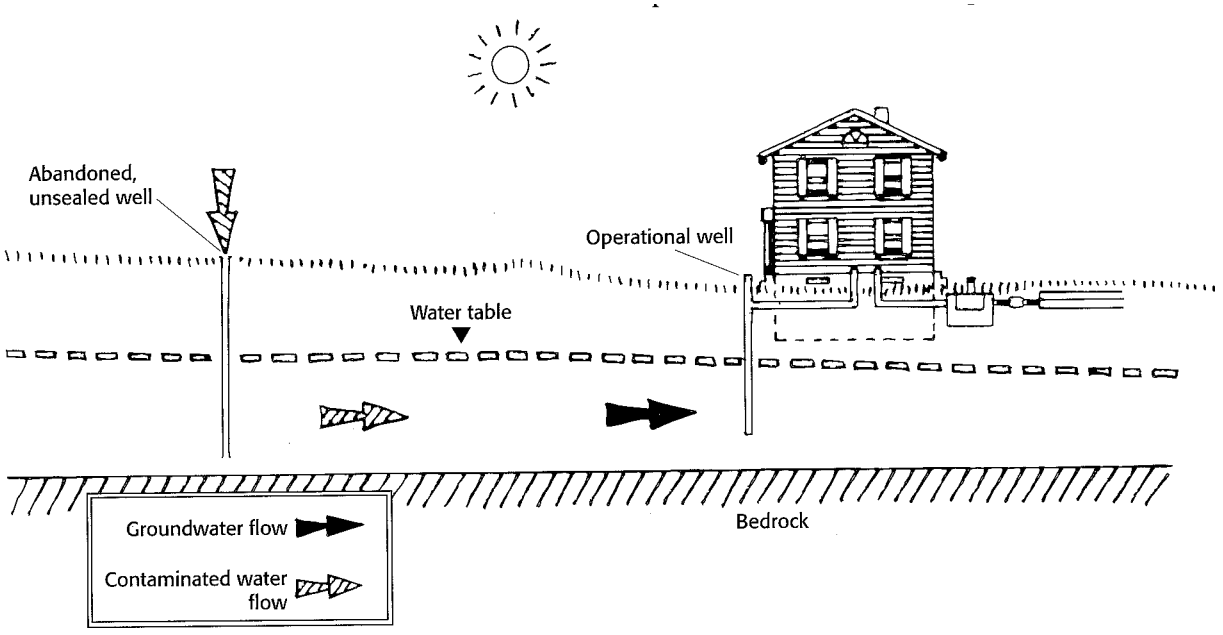
. . . continued on page 6

Risk Assessment Table for Well Water

. . . continued from page 5

	Low risk	Moderate risk	High risk	Your risk
Backflow protection	Measures are taken to prevent backflow and, where necessary, anti-backflow devices are installed	Measures are sometimes taken to prevent backflow; no anti-backflow devices are installed	No measures are taken to prevent backflow; no anti-backflow devices are installed	❑ low ❑ moderate ❑ high
Well inspection and "tune-up"	Inspected within the last 10 years	Inspected 10-20 years ago	Inspected > 20 years ago, or don't know when well was last inspected	❑ low ❑ moderate ❑ high
Unused wells on your property	No unused wells, or unused wells have been professionally sealed and capped	There are unused wells that are not sealed but are capped and isolated from contaminants	There are unused, unsealed wells that are in poor condition, near pollution sources, and/or uncapped	❑ low ❑ moderate ❑ high

If not properly filled and sealed, abandoned wells can provide a direct channel for waterborne pollutants to reach groundwater and contaminate household wells.



Your action plan

Now that you have assessed your well water source, you can take action to correct problems that may be health risks. For areas that you identified as high or moderate risk, decide what action you need to take and fill out the Action Plan below.

Write down all your moderate-risk and high-risk activities below	What can you do to reduce the potential risk for water pollution?	Set a target date for action
Samples of action items:		
Water hasn't been tested for 10 years; smells different than it used to	*Have water sample tested for contamination*	*One week from today*

This HAPPI document was adapted by Michael Robotham, Carl Evensen, and Linda J. Cox from *Drinking well water management* by Bill McGowan, Chapter 3, pp. 23–32, in *Home•A•Syst: An environmental risk assessment guide for the home*, developed by the National Farm•A•Syst/Home•A•Syst Program in cooperation with NRAES, the Northeast Regional Agricultural Engineering Service. Additional graphics are taken from *Protecting Your Resources Through a Farm and Home Assessment*. Permission to use these materials was granted by the National Farm•A•Syst / Home•A•Syst Office. HAPPI-Home materials are produced by the Hawaii's Pollution Prevention Information (HAPPI) project (Farm•A•Syst/Home•A•Syst for Hawaii) of the University of Hawaii College of Tropical Agriculture and Human Resources (UH-CTAHR) and the USDA Cooperative Extension Service (USDA-CES). Funding for the program is provided by a U.S. EPA 319(h) grant administered by the Hawaii State Department of Health.

Information about your well

It may be helpful to record additional information about your well. Fill in the spaces below with the requested information. Attach additional pages if you need more space.

Well construction and maintenance

Depth _____

Date constructed _____

Constructed by _____

Type of well _____

Last inspected _____

Inspected by _____

Water testing

Date tested _____

Testing lab _____

Contaminants found _____

_____

_____

Site information

Soil type _____

Depth to water table _____

Distance from potential pollution sources _____

_____

Current well uses

Primary _____

Pumping rate _____